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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/893,791	06/29/2001	Yutaka Kobayashi	PNDF-01068	4575

7590 03/01/2004

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EXAMINER	
CHU, CHRIS C	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 03/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/893,791	KOBAYASHI, YUTAKA	
	Examiner	Art Unit	
	Chris C. Chu	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1, 3, 4 and 16 - 23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3, 4 and 16 - 23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Request for Continued Examination

1. A request for continued examination (RCE) under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on December 1, 2003 has been entered. An action on the RCE follows.

Response to Amendment

2. Applicant's amendment filed on November 3, 2003 has been received and entered in the case.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1, 3, 4 and 16 – 23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "uneven roughness" in claims 1, 3, 4 and 16 – 23 is a relative term which renders the claim indefinite. The term "uneven roughness" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. That is, the limitation "uneven roughness," may potentially read on a roughness from a molecular scale to some unlimited dimension scale. Therefore, the limitation is not clearly written, hence the metes and bounds of the claims cannot be reasonably determined.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1, 3, 16, 17 and 21 are rejected under 35 U.S.C. 102(a)/102(b) as being anticipated by the acknowledged prior art.

Regarding claim 1, the acknowledged prior art discloses in e.g., Fig. 1 and page 2, line 2 – page 3, line 9 a semiconductor device, comprising:

- a semiconductor chip (100);
- a chip-mounting substrate (103) which is provided with said semiconductor chip mounted on a top surface thereof and first conductive pads (107) formed on a bottom surface thereof and connected with said semiconductor chip electrically;

- solder balls (106) formed on said first conductive pads;
- a printed circuit board (104) on which second conductive pads (108) connected with said solder balls are formed;
- a solder mask (at the bottom layer of the element 103) formed on a bottom surface of said chip-mounting substrate, said solder mask comprising a first uneven roughness; and
- underfill material (105) injected into a clearance formed between said chip-mounting substrate and said printed circuit board,
- wherein said first uneven roughness is formed on a surface which is brought into contact with said underfill material,
- wherein said first uneven roughness increases an area of a contact surface between said chip-mounting substrate and the underfill material, and
- wherein at least one of said first conductive pads and said second conductive pads comprises a second uneven roughness.

Inherently, any (e.g., metal, insulating, conductive, semiconductive, etc.) layers and films have some degree of "uneven roughness" at the molecular scale. Thus, the solder mask of the acknowledged prior art has the first uneven roughness and the at least one of said first conductive pads and said second conductive pads of the acknowledged prior art have a second uneven roughness.

Regarding claim 3, the acknowledged prior art discloses in e.g., Fig. 1 and page 2, line 2 – page 3, line 9 the first uneven roughness being shaped into at least one of a "slit-like" configuration and a "dimple-like" configuration.

Regarding claim 16, the acknowledged prior art discloses in e.g., Fig. 1 and page 2, line 2 – page 3, line 9 the printed circuit board having a "dimple-like" shaped configuration.

Regarding claim 17, the acknowledged prior art discloses in e.g., Fig. 1 and page 2, line 2 – page 3, line 9 a surface of said chip-mounting substrate having a "slit-like" shaped configuration.

Regarding claim 21, the acknowledged prior art discloses in e.g., Fig. 1 and page 2, line 2 – page 3, line 9 said uneven roughness being continuously formed on said solder mask.

7. Claims 4, 18, 19 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Kweon et al. '832.

Regarding claim 4, Kweon et al. discloses in e.g., Fig. 2A a semiconductor device, comprising:

- a semiconductor chip (21);
- a lead frame (23, 25 and 27) which is provided with the semiconductor chip mounted thereon and electrically connected with the semiconductor chip; and
- a printed circuit board (28) including conductive pads (29) which are formed thereon and brought into direct contact with a bottom surface of the lead frame,
- wherein the uneven roughness exists on the bottom surface of the lead frame and a surface of the conductive pads.

Inherently, any (e.g., metal, insulating, conductive, semiconductive, etc.) layers and films have some degree of "uneven roughness" at the molecular scale. Therefore, bottom surface of the lead frame and a surface of the conductive pads of Kweon et al. have the uneven roughness.

Regarding claim 18, Kweon et al. discloses in e.g., Fig. 2A a lead frame (23, 25 and 27) comprising a lead (25 and 27), said lead comprising an inner lead portion (25) connected to an outer lead portion (25), and said outer lead portion comprising the uneven roughness.

Regarding claim 19, Kweon et al. discloses in e.g., Fig. 2A – 2C the uneven roughness existing on contact surfaces between a pad (29) of said printed circuit board (28) and an outer lead (27) of said lead frame (23, 25 and 27).

Regarding claim 22, Kweon et al. discloses in e.g., Fig. 2A – 2C said lead frame comprising a lead, said lead comprising said bottom surface.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 20 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over the acknowledged prior art in view of Degani et al. '512.

Regarding claim 20, the acknowledged prior art discloses in e.g., Fig. 1 and page 2, line 2 – page 3, line 9 a semiconductor device, comprising:

- a semiconductor chip (100);
- a chip-mounting substrate (103) which is provided with said semiconductor chip mounted on a top surface thereof and first conductive pads (107) formed on a bottom

surface thereof and connected with said semiconductor chip electrically, said chip-mounting substrate including wirings (102);

- solder balls (106) formed on said first conductive pads;
- a printed circuit board (104) on which second conductive pads (108) connected with said solder balls are formed; and
- material injected (105) into a clearance formed between said chip-mounting substrate and said printed circuit board,
- wherein a first uneven roughness is formed on a contact surface between the wirings of said chip-mounting substrate and said solder balls,
- wherein the first uneven roughness exists on a bottom surface of said wirings, and said wirings are directly connected to said solder balls to form a joined surface, and
- wherein said second conductive pads comprise a second uneven roughness portion in contact with said solder balls.

Inherently, any (e.g., metal, insulating, conductive, semiconductive, etc.) layers, films and bumps have some degree of "uneven roughness" at the molecular scale. Thus, the contact surface between the wirings of said chip-mounting substrate and said solder balls of the acknowledged prior art has the first uneven roughness and the second conductive pads in contact with said solder balls of the acknowledged prior art has the second uneven roughness.

However, the acknowledged prior art does not disclose the wirings to be Cu. Degani et al. teaches in Fig. 1 IA and column 6, lines 18 - 22 wirings (221 - 224) to be Cu. It would have been obvious to one of Ordinary skill in the art at the time of the present invention was made to use

the Cu of Degani et al. in the wirings of the acknowledged prior art of Fig. 1 in order to (1) increase speed of the Input/output connections, (2) increase electrical conductivity and (3) increase resistant to corrosion by most natural waters as taught by Degani et al.

Regarding claim 23, the acknowledged prior art discloses in e.g., Fig. 1 said uneven roughness being continuously formed on said bottom surface of said Cu wiring.

Response to Arguments

10. Applicant's arguments with respect to claims 1, 4 and 20 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724. The examiner can normally be reached on 11:30 - 8:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 517-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

c.c.
2/20/04 3:26:35 AM

BRADLEY BAUMEISTER
PRIMARY EXAMINER